

Notice of Allowability

Application No.

09/667,651

Examiner

Jason M Perilla

Applicant(s)

POOR ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to The Amendment filed September 20, 2004.
2. ☒ The allowed claim(s) is/are 1-9, 11, 13-21, 23 and 25-26 renumbered as claims 1-22.
3. ☐ The drawings filed on _____ are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 12/04/03.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 20050105.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Theodore Naccarella on January 6, 2005.

The application has been amended as follows:

The following versions of claims 1, 4, 5, 8, 9, 13, 14, 16, 17, 21, 25, and 26 replace the instant versions of the corresponding claims in the application in their entirety.

1. An apparatus for performing beamforming on a plurality of signals in a reception channel received from a receiving antenna array, said signals including simultaneous data signals from a plurality of transmitters, said circuit comprising:

an Nx1 switched beam beamforming circuit for weighting and combining outputs of N antenna receiving elements ~~and generating~~ to generate a plurality of beam signals and selecting for output a single beam signal therefrom based on a beam scheduling sequence, wherein N is an integer greater than 1;

a beam schedule generating circuit for generating said beam scheduling sequence used by said Nx1 switched beam beamforming circuit for switching between

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ones of a said plurality of beams signals for output ~~for generation by said beamforming circuit;~~

a frequency downconverting circuit for converting said the selected single beam signal to a baseband signal; and

a multi-path/multi-user estimation circuit for generating from said baseband signal path estimates and path estimate errors for each of said ~~multiple simultaneous data signals transmitters from said baseband beam signal.~~

4. The apparatus of claim 3 wherein said beam schedule generating circuit switches said selected single beam signal at a rate faster than a data rate of said signals in said reception channel.

5. The apparatus of claim 3 wherein said apparatus is adapted to receive spread spectrum signals, said spread spectrum signals having a chip rate, and wherein said ~~control~~ Nx1 switched beam beamforming circuit switches said selected single beam at said chip rate.

8. The apparatus of claim 4 wherein said beam schedule generating circuit revises said beam scheduling sequence at predetermined intervals, said beam schedule generating circuit controlling said Nx1 switched beam beamforming circuit in accordance with repetitions of a given beam scheduling sequence until revised.

9. The apparatus of claim 8 further comprising a memory and wherein said beam schedule generating circuit stores each beam scheduling sequence in said memory and retrieves said beam scheduling sequence from said memory to be used for controlling said Nx1 switched beam beamforming circuit during a period said beam scheduling sequence is used ~~said interval of its use~~.

13. A method for performing beamforming on a plurality of signals in a reception channel received from a receiving antenna array, said signals including simultaneous data signals from a plurality of transmitters, said method comprising the steps of:

(1) weighting and combining outputs of N antenna receiving elements and generating a plurality of beam signals and selecting for output a single beam signal therefrom based on a beam scheduling sequence, wherein N is an integer greater than 1;

(2) generating said beam scheduling sequence used in step (1) for switching between ones of a said plurality of beams signals as the selected single beam signal ~~for generation by said beamforming circuit~~;

(3) converting said selected single beam signal to a baseband signal; and

(4) generating path estimates and path estimate errors for each of said ~~multiple~~ simultaneous data signals ~~transmitters~~ from said baseband beam signal.

14. The method of claim 13 further comprising the step of converting said selected single beam signal from analog to digital between steps (3) and (4).

16. The method of claim 15 wherein step (2) comprises switching between said plurality of beam signals at a rate faster than a data rate of said signals in said reception channel.

17. The method of claim 15 wherein said signals in said reception channel are spread spectrum signals, said spread spectrum signals having a chip rate, and wherein step (2) comprises switching between said selected plurality of beam signals at said chip rate.

21. The method of claim 20 further comprising the steps of:

(5) storing each beam scheduling sequence in a memory; and

(6) retrieving said beam scheduling sequence from said memory to be used for controlling said beamforming circuit switching between ones of said plurality of beam signals for output during a period said beam scheduling sequence is used.

25. The apparatus of claim 5 wherein said beam schedule generating circuit generates said beam scheduling sequence by solving

$$\hat{f}_k = \hat{f}_k, \text{ for } k=0,1,\dots,G-1$$

$$\hat{F}_{G-1} = \arg \max_{F_{G-1}} Tr\{JP_{G-1|G-1}(F_{G-1})\};$$

and setting

$$\underline{\hat{f}_k = \hat{\hat{f}}_k, \text{ for } k = 0, 1, \dots, G - 1}$$

wherein

k is a time index;

$\underline{\hat{f}_k \hat{\hat{f}}_k}$ is the time varying switch-beamforming vector based on a closed loop

control function;

$\underline{\bar{f}_k \hat{\hat{f}}_k}$ is the time varying switch-beamforming vector based on an open loop

control function;

$$\hat{F}_{G-1} = (\hat{f}_0, \hat{f}_1, \dots, \hat{f}_{G-1});$$

G is the processing gain;

J is a weighting matrix; and

$P_{G-1|G-1}(F_{G-1})$ is the error covariance matrix.

26. The method of claim 17 wherein step (2) comprises generating said beam scheduling sequence by solving:

$$\underline{\hat{f}_k = \hat{\hat{f}}_k, \text{ for } k = 0, 1, \dots, G - 1}$$

$$\hat{F}_{G-1} = \arg \max_{F_{G-1}} Tr\{JP_{G-1|G-1}(F_{G-1})\};$$

and setting

$$\underline{\hat{f}_k = \hat{\hat{f}}_k, \text{ for } k = 0, 1, \dots, G - 1}$$

wherein

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k is a time index;

$\underline{\hat{f}_k}$ is the time varying switch-beamforming vector based on a closed loop

control function;

$\overline{\hat{f}_k}$ is the time varying switch-beamforming vector based on an open loop

control function;

$$\hat{F}_{G-1} = (\hat{f}_0, \hat{f}_1, \dots, \hat{f}_{G-1});$$

G is the processing gain;

J is a weighting matrix; and

$P_{G-1|G-1}(F_{G-1})$ is the error covariance matrix.

Claims 1-9, 11, 13-21, 23 and 25-26 renumbered as claims 1-22, and the claim dependency is renumbered accordingly.

Allowable Subject Matter

2. Claims 1-9, 11, 13-21, 23 and 25-26 renumbered as claims 1-22 are allowed.

3. The following is an examiner's statement of reasons for allowance:

The claims are allowable over the prior art of record because the prior art of record does not disclose or obviate the $N \times 1$ switched beam beamforming circuit wherein a beam is generated by the weighting and combining of the N elements of an antenna array and selected for output according to a beam scheduling sequence which may be utilized to selectively vary among a plurality of generated beam signals available for

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output. The Applicant's Admitted Prior Art (AAPA) in view of Kuwahara et al (US 6141335) does not specifically address the invention as claimed as persuasively argued in the response to the last office action. The AAPA in view of Kuwahara et al would not lead one of ordinary skill in the art to arrive at the claimed invention because a combination of the two could not meet the limitations of the claimed invention.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M Perilla whose telephone number is (571) 272-3055. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on (571) 272-3056. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Jason M. Perilla
January 6, 2005

jmp



CHIEH M. FAN
PRIMARY EXAMINER